

Model comparison of corrosion rate on saline and fresh water environments

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To Cite:

Achinike W, Ekperi NI, Achinike OW. Model comparison of corrosion rate on saline and fresh water environments. *Discovery* 2023; 59: e6d1009

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Peer-Review History

Received: 26 November 2022

Reviewed & Revised: 28/November/2022 to 09/December/2022

Accepted: 12 December 2022

Published: January 2023

Peer-Review Model

External peer-review was done through double-blind method.

Discovery

pISSN 2278-5469; eISSN 2278-5450

URL: <https://www.discoveryjournals.org/discovery>



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ABSTRACT

In this research work, two coupons of equal mass were immersed in saline and fresh water environment respectively. The immersed coupons were observed to have lost weight. Their weight loss which was as a result of corrosion was measured periodically at intervals of one week for a total period of two months. The corrosion rates of the two different environments were then determined and compared accordingly. The fresh water, specimen the corrosion rate was slightly high in the beginning of the experiment but then continued at an approximate constant rate with an increase at the last week of the experiment, the low number of ions in the waters were responsible for this behavior since the available oxygen and the medium will form a corrosion cell and initiate the corrosion process until passive films were formed then rate became constant. The examinations show that the corrosion rate in a saline environment is double of the corrosion rate in a fresh water environment.

Keywords: corrosion, environmental, comparison, saline, fresh water

1. INTRODUCTION

Corrosion is defined as the undesirable deterioration of metals and metal alloys as a result of interaction with its environment. A broader definition considered the degradation of material of construction including concrete, plastics, ceramics, rubber and other non-metallic materials. Corrosion in most cases is triggered off by the presence of moisture films on the surface of the metal. Metals whether attacked informally or pit in corrosion, are all corroded by the same basic mechanisms, which are different from those of other materials.

The advancements in the world today has made steel and alloy of ions very acceptable for use in different engineering facilities, basically for the manufacturing of equipment and construction of structures, with the increased utility of this alloy comes alongside issues of excessive interest which includes issues of the control of corrosion rate when the steel is exposed to different corrosive environment. For the effective use of steel in construction and equipment manufacture, there is the need to consider the corrosion rate overwhelming this metal. The approach towards this phenomenon involves a basic knowledge of the structural features of the metal, the component data of the environment and mechanism of the corrosion reaction that occurs at the metal-environment interface. This enquiry is obviously necessary because corrosion

accounts for the single largest motivator of plant breakdown in the oil and gas industries. It is also a fact that every developed nation spends 5% of its budget on corrosion related problems and maintenance. This consequence is as a result of the location of these industries, which are mostly at marine environments and have their direct atmosphere polluted by corrosion stimulating gases.

The presences of these gases in the atmosphere buttresses the fact the atmospheric corrosion is the largest cause of equipment failure on the tonnage basis. Even though corrosion can be consequential, it also has its merit side and the example is in the case of dry corrosion (corrosion involving metal and gas or metal and vapour) the layer of films formed by the corrosion reaction gives a protective covering over the metal, which leaves the corrosion rate constant instead of increasing. Another case is that of etching where a metal surface is intentional corrode, for the exposure of its internal structure needed for the study of the metal. Corrosion rate depends chiefly on the conductivity of the electrolyte involved and the availability of oxygen. It also has various forms, which will be highlighted later in this project work, the type of corrosion, which occurs, depends on the metal involved and the components of the environment it is used in.

This research work is focused on comparing the effect of corrosion on mild steel, exposed to different corrosive environments especially saline and fresh water environment in order to create avenue for useful suggestions that would lead to inhibition. Identification of the extent at which mild steel, corrode in different environment, precisely saline and fresh water so that more contribution can be made towards the utmost control of corrosion processes. Also, to elucidate ways by which corrosion is been monitored in up steam industries to enhance effective utilization of the saline and fresh water systems of process plant in Shell Petroleum Development Company (SPDC) and to achieve optimum productivity of the operating system.

2. MATERIALS AND METHOD

Uniform sizes of mild steel were exposed to different corrosive environment and were left for a period of one week in saline and fresh water environment to compare the weight with the first reading of weight which is gotten from the two pieces of mild steel before my experiment start. This method of analysis was considered reliable on these bases that the corrosion rate of a metal will vary in different environment because of the distinguishing corrosive properties of these environments. In this experiment, two different water environments were chosen such as Salt Water and fresh Water Environment. Mild steel was exposed to the corrosive properties of the environments, the results obtained were then used for the analysis and effect of corrosion on mild steel.

Apparatus

Two 7.9cm mild steel rods with diameter 1.3 and weighing of 69.81g. Sand paper were brushed and chiseled. Top load balance. Two 30cl experiment bottles and 20cl of fresh water and salt water.

Procedure

Two mild steel rods were properly cleaned using wire and sand paper to remove any previous film, possibly formed during exposure taking precaution not to create crevices on the metal. The metals were washed very clean and allowed to dry and cool properly. The rods were weighed on a top load balance to take note of the initial weights with subsequent adjustment of the rods using chisel until the two rods adjust to an equal weight.

The liquids were poured into the experimental bottles and two of the rods immersed into these bottles and labeled. An appropriate area in the chemical engineering laboratory was sat for this experiment to be fully completed to total period of 8 weeks, which the both rods was fixed in different solution, one in the saline water and the other in fresh water environment. In consideration of the limited time available for the experiment, the period did not give a wide margin for weight variation and so small weight loses were expected. Nevertheless, the weight variation was enough for an appreciable analysis and reliable conclusion.

3. RESULTS AND DISCUSSION

Table 1 shows the computations of various weight samples of both specimen A and B for each week of the experiment. Table 2 shows the computations of various weight loss experienced for both specimen A and B for each week of the experiment and it is graphically illustrated in Figure 1. Table 3 shows the corrosion rate of collected samples of specimen A and B for the various weeks of the experiment. The trend was illustrated in Figure 2.

Table 1 Weight of Samples

Environment	Initial	Wk1	Wk2	Wk3	Wk4	Wk5	Wk6	Wk7	Wk8
Specimen A	76.53	76.50	75.55	74.73	73.70	73.80	72.80	72.50	71.78
Specimen B	76.53	76.52	76.50	75.80	74.82	73.94	73.64	72.80	71.90

Table 2 Weight Loss of Samples

Environment	Initial	Wk1	Wk2	Wk3	Wk4	Wk5	Wk6	Wk7	Wk8
Specimen A	0	0.03	0.98	1.75	2.73	2.75	3.95	4.47	4.98
Specimen B	0	0.01	0.03	0.73	1.71	2.59	2.45	3.28	3.45

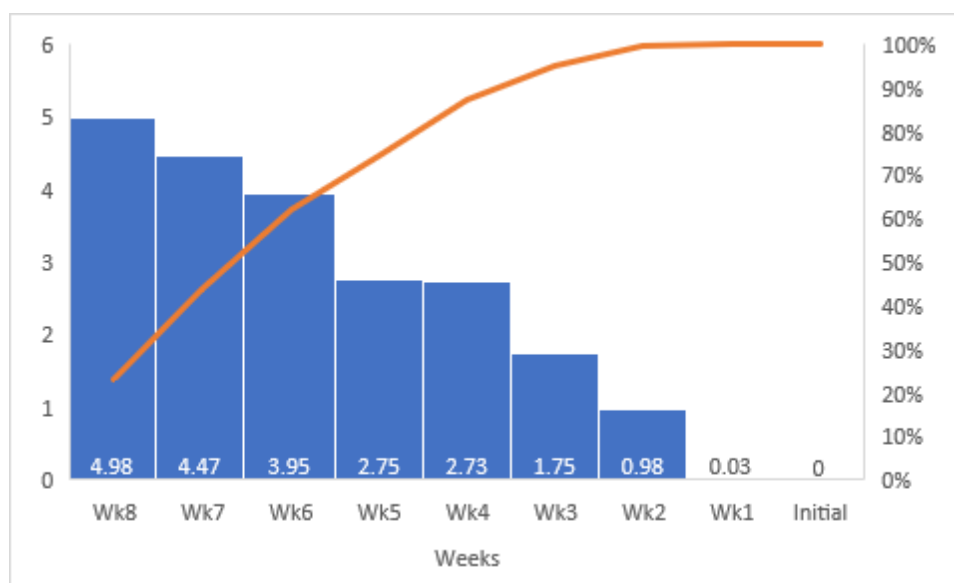
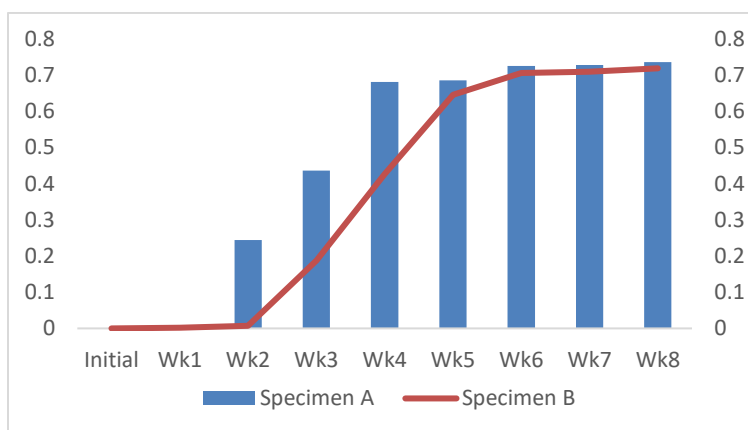
**Figure 1** Graph of weight Loss of Samples

Figure 1 Demonstrates levels of weight loss across each week of the experiment. It shows that in the beginning of the experiment, the weight loss was minimal but continues to increase as the experiment proceeds. According to the trend of the graph, the weight loss was at little as 0.03 in the first week and rose to 4.98 at the eight weeks of the experiment. Figure 2 demonstrates the rate of changes in corrosion of the samples collected from saline and fresh water environments subjected into close examination within the period of eight weeks.

**Figure 2** Corrosion Rate of samples**Table 3** Corrosion rate of Samples

Environment	Initial	Wk1	Wk2	Wk3	Wk4	Wk5	Wk6	Wk7	Wk8
Specimen A	0	0.0074	0.2442	0.4361	0.6806	0.6854	0.7255	0.7278	0.7355

Specimen B	0	0.0023	0.0074	0.1879	0.4262	0.6455	0.7060	0.7095	0.7185
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Result analysis

The analysis results show that corrosion occurred due to weight losses. The impact of corrosion for the various specimens varied increasingly as seen in Figure 1 and 2 above. It was observed that in the first three weeks the corrosion rates were slow then began to increase as from week 4, thus corrosion commenced, but the weight loss in general was small compared to the specimens in the salt water environment. The type of salts present in the second environment was not critically accounted for, but the corrosion rate was not too tense, the presence of sodium hydroxide is anticipated including low amount of saline chloride.

For the fresh water, specimen the corrosion rate was slightly high in the beginning of the experiment but then continued at an approximate constant rate with an increase at the last week of the experiment, the low number of ions in the waters were responsible for this behavior since the available oxygen and the medium will form a corrosion cell and initiate the corrosion process until passive films were formed then rate became constant.

4. CONCLUSION

The comparison of corrosion rate in saline and fresh water environment has been studied. Under these conditions, corrosion rate was found to be very high with saline water polluted than that of the fresh water. At the end of this experiment the following conclusions were found necessary; the rate of corrosion of mild steel in these various media decreases in the following order: Saline water, fresh water. The rate of corrosion is proportional to period of exposure. Corrosion will proceed at a faster rate in the presence of ions. Corrosion is directly proportional to be weight loss.

Ethical approval

Not applicable.

Informed consent

Not applicable.

Conflicts of interests

The authors declare that there are no conflicts of interests.

Funding

The study has not received any external funding.

Data and materials availability

All data associated with this study are present in the paper.

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